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ABSTRACT

This resource monograph is one of a series designed as a teaching guide for field studies. Each guide centers around the exploration, observation, and interpretation of a field site in one of the four geological areas of Florida. Incorporated into the guides are many of the subject-matter schemes of the Earth Science Curriculum Program (ESCP) and three major process schemes: science as inquiry, comprehension of scale, and prediction. Each guide gives the teacher information on the planning and execution of the field trip, as well as educational objectives, learning activities, and teaching materials available. This particular resource guide is concerned with a field trip along the east coast of Florida. It provides the teacher and secondary students with the opportunity to observe the topography of Florida, evidences of former stands of sea level, mineral resources of the area, and shoreline features of the east coast. Areas included in the trip are Fowler's Prairie, Devil's Sink, Lady Slipper Lake, and Florahome Valley. Photographs and maps of the area covered are an integral part of the guide. A road log and bibliography conclude this teacher resource. (MA)

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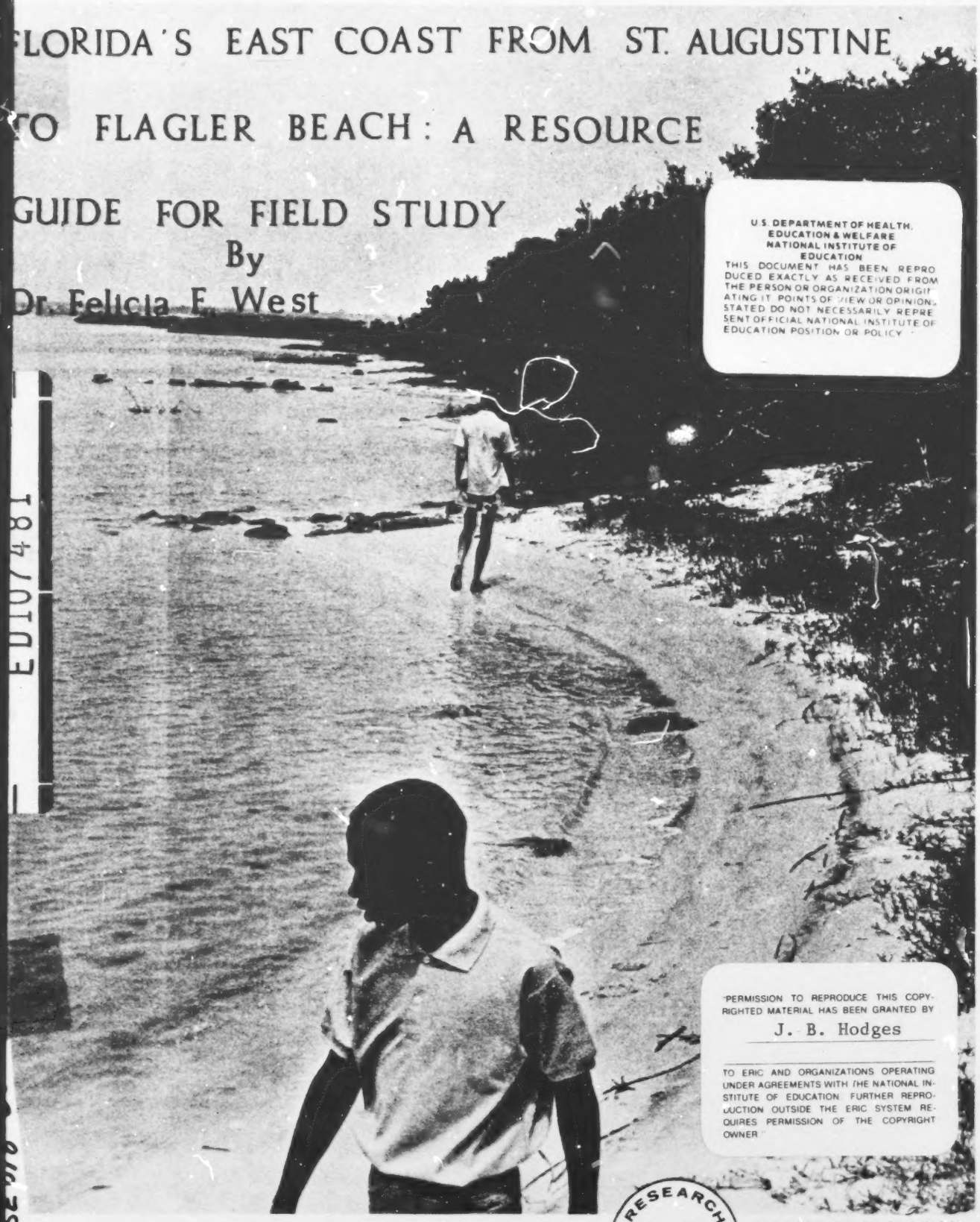
FLORIDA'S EAST COAST FROM ST. AUGUSTINE TO FLAGLER BEACH: A RESOURCE GUIDE FOR FIELD STUDY

By
Dr. Felicia E. West



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P.K. YONGE LABORATORY SCHOOL

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RESOURCE GUIDE FOR FIELD STUDY: ST. AUGUSTINE TO FLAGLER BEACH

By

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February, 1974

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Dr. Felicia E. West

PREFACE

As one becomes more and more aware of the need to understand the earth and its forces and processes responsible for changes associated with the earth as well as its water and its air, a concomitant need develops to encourage teachers and students to study these forces and processes firsthand through the use of field studies. It is believed that in-service teachers need encouragement and assistance as they become involved in the use of this teaching technique and in the use of their communities' resources. With this need in mind, a series of monographs has been prepared by Dr. Felicia E. West at P. K. Yonge Laboratory School. The series presents a case study and resource guide to sites characteristic of four geological areas in the State of Florida.

The case study presents the methods and techniques of planning which include familiarization with the area by the teacher, development of goals and objectives for the study, pre-trip classroom activities, field-trip activities, follow-up activities, and evaluation by the students and teachers involved. In addition, administrative details and the logistics of planning are treated.

Field resource guides have been developed for Little Talbot Island State Park on Florida's northeast coast; for the Devil's Millhopper, a large "collapse sink" near Gainesville; for the Cedar Keys area on Florida's west coast; and for the Flagler Beach area on the Florida east coast. Material which relates to the area between Gainesville and the east and west coasts is included in the guides for the coastal areas. Each of these guides presents geological background information on the area, suggested activities for study in several curriculum areas, safety factors to be considered, and maps and routes. Information which is considered beneficial to teachers as they plan to visit these areas is also included.

The peninsula of Florida is divided into two primary provinces. The central portion of the peninsula in which Gainesville is located is referred to as the Central Plateau or the Central Highlands; the area between Gainesville and the coast is referred to as the Terraced Coastal Lowlands. The subject of this monograph is the area on the Central Plateau from Gainesville and across the Terraced Coastal Lowlands to Flagler and Crescent Beaches.

It is hoped that the information included in this monograph will provide some stimulus, assistance, and encouragement to classroom teachers as they plan field studies to this highly interesting area. Your reactions to these materials will be appreciated and will aid us in preparing similar materials in the future.

Additional copies of this monograph and others in the series may be had by contacting P.K. Yonge Laboratory School.

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INTRODUCTION

This document discusses educational purposes, age levels, teaching units, and activities to which the site is best adapted; teaching aids available; safety factors to be considered; times available for visitation; and number restrictions on visitors. It is suggested that the teaching style strive to sustain inquiry by encouraging questions, explanations, extrapolations, and speculations based upon the problems themselves.

In developing field guides for the study of the site within the framework of earth science, many of the subject-matter schemes around which the Earth Science Curriculum Program (ESCP) is built should be kept in mind. These schemes encompass:

Universality of change
Flow of energy in the universe
Adaptation to environmental change
Conservation of mass and energy in the universe
Earth system in space and time
Uniformitarianism, a key to interpreting the past.

The three major process schemes which are to be woven throughout the program are:

1. Science as Inquiry: a search for accurate knowledge and a recognition of the incompleteness and uncertainty of present knowledge; unsolved problems; logical and systematic developments of conclusions from accurate observations and well-chosen hypotheses.

2. Comprehension of Scale: the use of scales of measurement or units appropriate to the problem; the use of models for the enlargement or reduction of a scale; skill in devising and using models; and an intuitive feeling for scale in the real world and in models.

3. Prediction: extrapolation from the known to the unknown in either space or time; making logical interpretations of past events from fragmentary records; interpreting past events on the basis of given data.

The survey to select sites for the development of the field guide included exploration, observation, and interpretation of each site. Sites which showed only a few processes

or features, but showed them at their best, were not eliminated. Some of the following evidences of dynamic changes on the earth's surface are illustrated by the sites reported in this series of monographs.

a. Stream evolution
b. Beach erosion and deposition
   (1) Atlantic Coast—relatively high energy
   (2) Gulf Coast—relatively low energy
c. Dune formation and evolution
d. Costal features and their formation
   (1) Barrier bars
   (2) Lagoons
   (3) Islands
   (4) Spits and others
e. Relic terraces as evidence of glacial-eustatic fluctuations of sea level
f. Karst topography and its development in the lime-sink area
g. Geologic history of Florida from fossil records
h. Economic geology
   (1) Lime rock quarries
   (2) Phosphate mines
   (3) Heavy mineral mines.

The exact sites and routes were selected in order that as many concepts and principles as possible could be developed. Worthwhile student activities are suggested; sets of slides, for which representative prints are included in the monograph, were produced to aid in the teacher's pre-planning and post-discussion of the trip; a bibliography of literature available for the area is included for the teacher's use; and any additional information considered useful to the teacher making the trip is made available.

Two means of assessing field trip experiences were developed in conjunction with The Case Study of Hogtown Creek and are presented in that monograph. Included also in the case study are models for a student field guide and for development of behavioral objectives and activities for field trips. This monograph and the others in the series are available on request from P. K. Yonge Laboratory School.

A list of sites for which additional trips have been developed, subjects of other monographs, is given below.

a. The Devil's Millhopper—karst topography and fossil and stratographic records (Resource Monograph #2)
b. Little Talbot Island State Part—coastal features and their formation (Resource Monograph #3)
c. Cedar Keys area on the Gulf Coast—coastal features and their formation (Resource Monograph #5).

RESOURCE GUIDE FOR FIELD STUDY:
ST. AUGUSTINE TO FLAGLER BEACH

Background and Description

Taking this field trip provides the opportunity for observation of the topography of Florida, evidences of former stands of sea level, mineral resources of the area, and shoreline features of the east coast. The Eocene limestones, present under most of the Floridian peninsula, are generally not exposed in this area. Deposits which may be observed are the sands and clays of more recent periods. These include sand pits, kaolin mines, karst features, peat deposits, fossils from old sea bottoms, coquina deposits, and many shoreline features characteristic of a high-energy coast. The trip has been divided into sections for mapping only (Figures 1-7).

The trip begins at the intersection of Florida 24 and University Avenue where the elevation is about 150 to 160 feet a.s.l. Florida 20 leads out of Gainesville toward Palatka and passes just south of Newnan's Lake (Figure 1). The elevation changes along this route until at the lake the height above sea level is about 70 feet. This lake is classified as a "perched lake" and is at about the same elevation as Hogtown Prairie located on the Limestone Plain. The Ocala Limestone is evidently buried much deeper here. The Lake has a mud bottom and receives its water from several creeks draining the Central Highlands. The primary creeks draining this area are the Hatchett Creeks. Several smaller creeks drain the general area immediately around the lake. The lake's outlet is through Prairie Creek at the south end, Camp's Canal, and the River Styx. Camp's Canal connects Prairie Creek, the outlet channel, and the River Styx, the inflow channel to Orange Lake. Lochloosa and Orange Lakes are, in turn, connected by Cross Creek and share surface outlets which form Orange Creek, a tributary of the Oklawaha River. In light of elevation, the three lakes form a basin which slopes from about 160 to 190 feet to about 30 feet above sea level near the mouth of Orange Creek. Newnan's Lake is about 9 feet higher than Orange Lake, and Lochloosa is about one foot higher than Orange Lake. A shallow dam, constructed to stabilize the level of Newnan's Lake, may be viewed while crossing Prairie Creek.

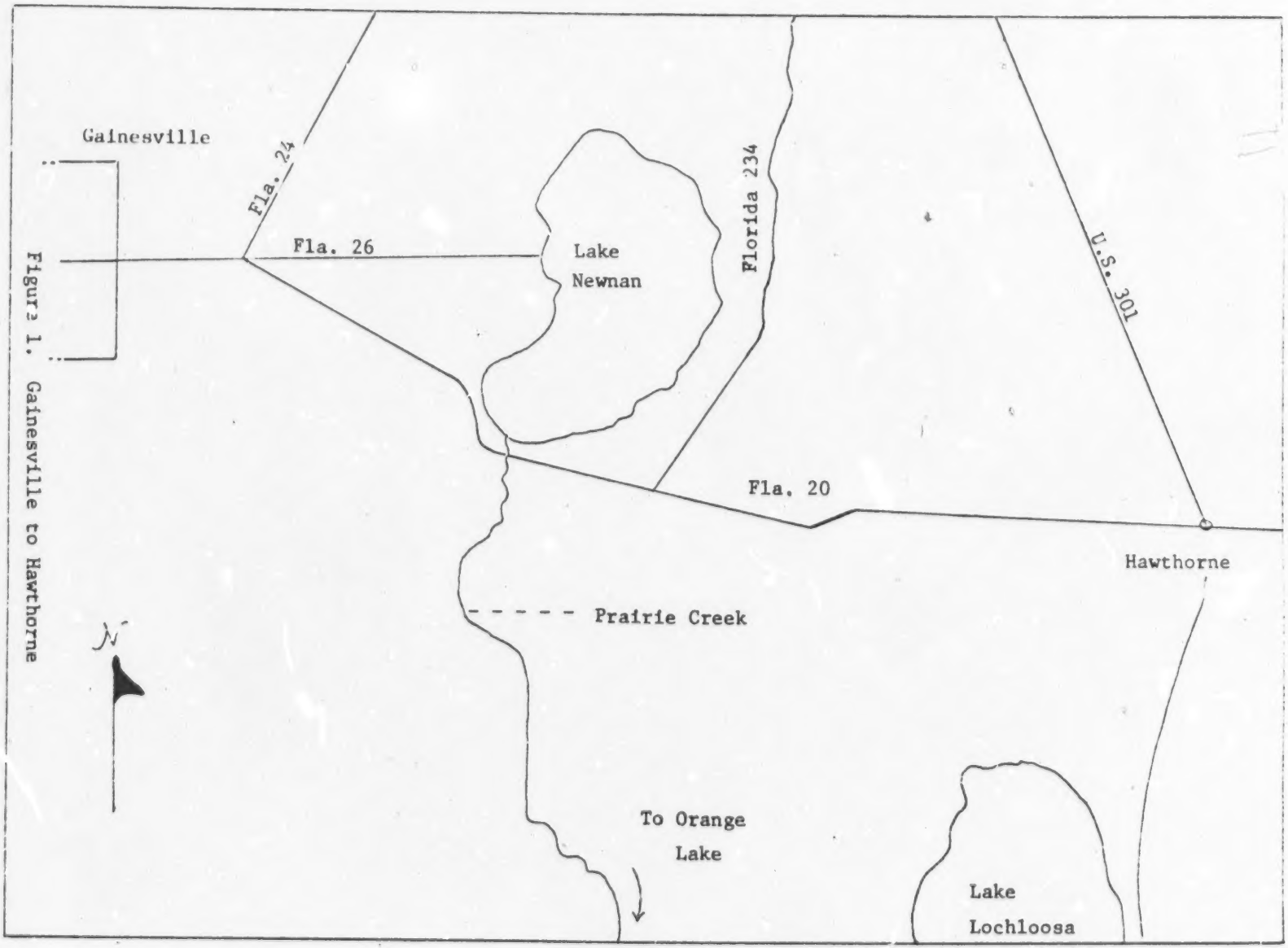


Figure 1. Gainesville to Hawthorne

The area around Newnan's Lake is covered with a mixture of flat woods and hammocky vegetation. The typical flatwoods areas are low-level, poorly drained areas underlain with hardpan or clay; hammocks are groves of hardwood trees located in moist ground. In the more moist areas are the magnolia-bay-holly complex.

The route from Newnan's Lake to Grove Park, even though the elevations are near the 100-foot level, traverses a swampy area. Cypress ponds and standing water in ditches occur on both sides of the road. These features indicate an underlying hardpan or impermeable layer. Grove Park is situated on a small area of somewhat higher ground than the surrounding land. If a map is studied, the small towns all seem to be situated on these small hammocks with the roads and trails stretching from hammock to hammock.

East of Grove Park the route crosses Lockloosa Creek where the elevation is approximately 70 feet a.s.l., contrasting with the lake's elevation of about 60 feet a.s.l. The source of this creek is within one and one-quarter miles of Big Lake Santa Fe and is at an elevation of about 160 to 190 feet above sea level. This marks the drainage divide of peninsular Florida, since Lochloosa ultimately drains into the Atlantic while Big Lake Sante Fe drains through the Santa Fe River to the Gulf of Mexico via the Suwannee River. This entire area north of the highway is composed of numerous swamps and lakes. Many of the lakes appear to be merely relics of once much larger lakes.

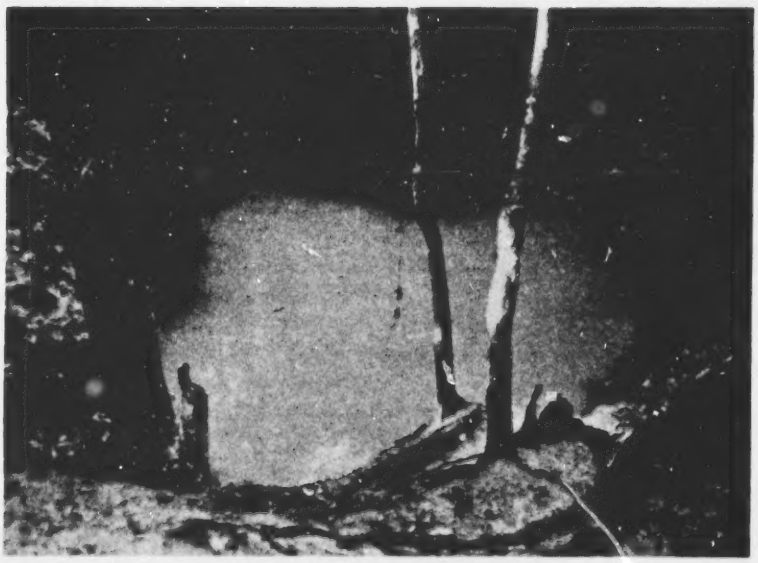
Upon arrival at the town of Hawthorne, one finds himself on another hammock with elevations ranging from 130 to 155 feet a.s.l. Solution features—depressions, resulting from solution at depth, and sinks, resulting from collapse of the limestone below—begin to appear. Fowler's Prairie (Plate 1), filled with peat of the same type as is the Florahome deposit, is one of the many occurring in this area. These prairies are old solution basins found at the southern extent of Trail Ridge. The numerous depressions east of Hawthorne and Fowler's Prairie are the result of subsidence. The great depth of sand over limestone collapses as solution occurs far below the surface. These collapsed features result in a characteristic, gently rolling surface. There are numerous sinks, however, that do occur on the uneven erosional surface of the limestones. Devil's Sink (Plate 2) may be seen if one hikes up the hill across from Lady Slipper Lake (Plate 3). The sink is partially filled with water standing at approximately the same level as that in Lady Slipper Lake or about the 90-foot level.

The soils here are orange-colored sands. To the south of this highway are mines removing both sands and gravels from this area. (See Plate 4.) The soils have little

PLATE 1

Fowler's Prairie

PLATE 2



Devil's Sink

PLATE 3

Lady Slipper Lake

PLATE 4

Sand pit

nutrient value, primarily supporting rosemary, scrub oak, and a few pines. Few gardens or farmlands are to be seen. Kaolin is being mined at Edgar but not elsewhere in the area. The high iron content of the clays makes them of little economic value.

At Interlachen the route to be followed turns left at the junction of Florida 20 and Florida 315 (see Figure 2). Route 315 is followed north to Grandin and a junction with Florida 100. This area is marked by numerous lakes, prairies, and sinks. The high point is that near Grassy Lake which has an elevation of about 200 feet a.s.l. One of the lower points is the Florahome Valley (Plate 5) where the elevation is about 80 feet a.s.l. The area around Interlachen and Florahome is blessed with rich deposits of sand, gravel, and peat. Sands and gravels are mined at Putnam Hall, Grandin, Johnson, and Interlachen. Florahome has a large deposit of peat which is mined commercially.

PLATE 5

Florahome Valley

A small abandoned pit on the left side of Florida 315 (see Road Log) illustrates cross-bedding in the sands

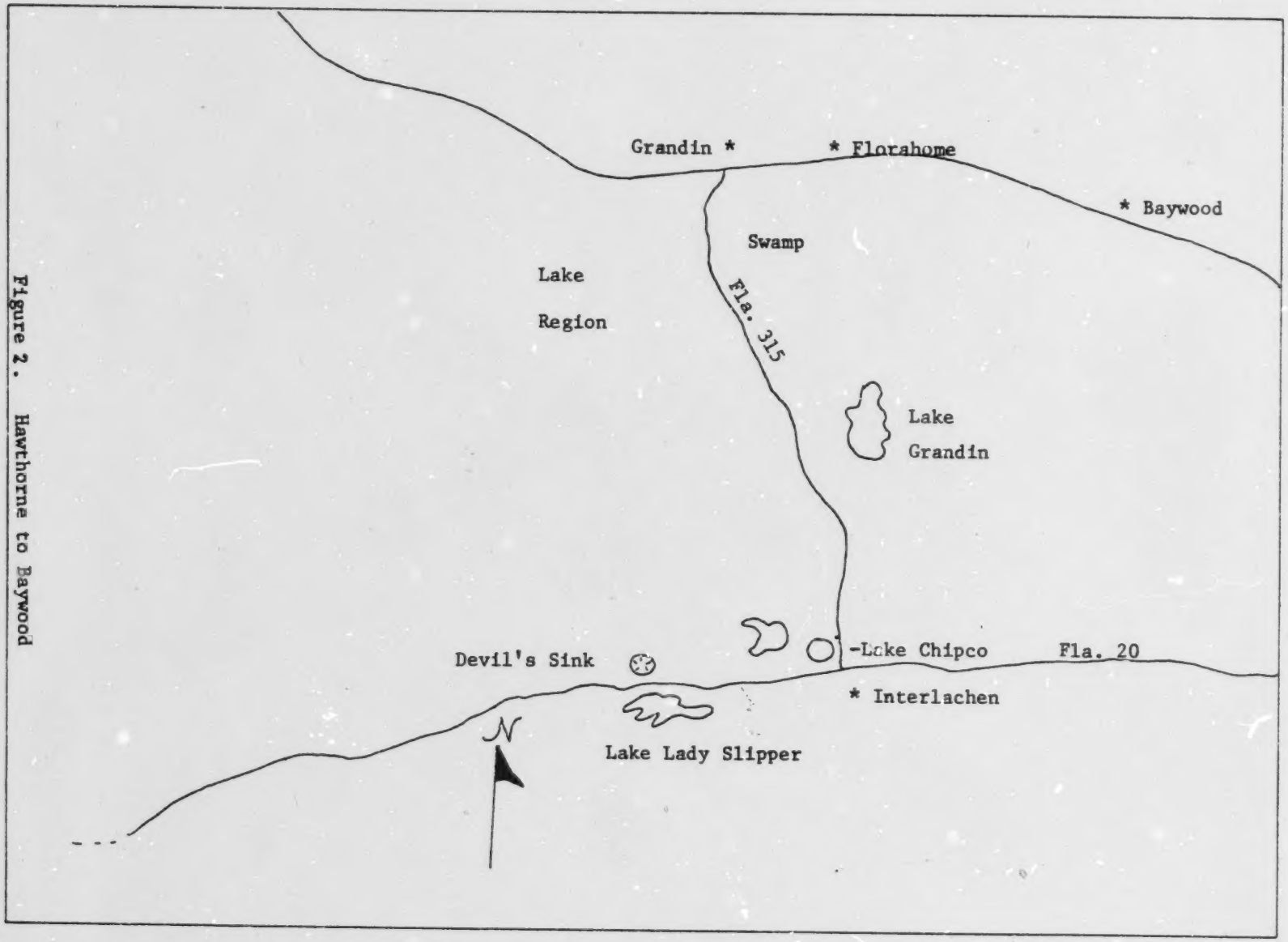


Figure 2. Hawthorne to Baywood

(see Plate 6). Paleontologically the area is practically barren. Casts of burrows may be seen in a mine just east of Interlachen. Small pebbles, oblate spheriods in shape, are found in the pit on Florida 315. The pebbles serve as miniature cap rocks, and the sides and floor of the pit are covered with small pedestals.

PLATE 6

Cross-bedding in sand bank

North of this sand pit, the road passes through a region of more orange sands, pockmarked with depressions, lakes, and sinkholes. Lake Grandin is believed to be part of a larger lake which existed in the past, possibly as recently as the early 1900s. The northern part of this low area extends far northward beyond Grandin. The features of this area have been shaped by solution of the underlying limestones and by physical erosion of their surfaces by wind and rain and the associated running water.

The area to the west near Putnam Hall has no natural surface drainage; to the east is Etonia Creek which drains the remnants of Lake Grandin and the area to the north and west. Several of the lakes in the triangular section formed by Florahome, Putnam Hall, and Interlachen have apparently formed by the coalescing of several collapsed sinks. It is suggested that sinks formed before and after the last stand

of sea level can be differentiated. The older sinks are covered by deposits of white sand, have gently sloping sides, and generally appear to have suffered alteration over the ages. The younger sinks do not have white sand deposits associated with them and have the steep sides as Devil's Millhopper and Devil's Sink.

This area is underlain by clays and sands of the Hawthorne materials. These provide an impermeable layer, and most lakes and shallow sinks are perched above the primary aquifer. Devil's Sink or Devil's Pit on Florida 20 has penetrated the Hawthorne materials and connects with the regional aquifer (3).

After reaching Grandin the route turns eastward on Florida 100 toward Palatka. Moving down the grade on Florida 100, one enters the Florahome Valley. The town of Florahome is sitting on an "island" surrounded by lower elevations on all sides. The valley is about five miles long and two miles wide with an elevation of about 90 feet. This valley is noted for a pond-prairie peat deposit which is mined commercially. The deposit is quite widespread but fairly shallow and is found in a relatively well-drained area. The peat is mined by draglines to a depth of about five feet. The cavities fill with water which is drained off by a series of ditches. Although the owners of the mine do not encourage visitors on the mining site, they do not object to students visiting the area where the peat is dried and processed. Samples of fresh peat may be collected here and returned to the laboratory for examination. The materials making up the peat provide bits of evidence for interpreting the past environment.

The eastern side of this valley is bordered by the Baywood Promontory, presumably a sand ridge which developed as a spit. Baywood is at an elevation of about 200 feet while the swampy areas south of Baywood are at an elevation of about 100 to 150 feet. The swampy areas southeast of Grandin and southwest of Florahome, on the other hand, are at elevations of less than 90 feet. East of the promontory, the route crosses Rice Creek Swamp where the elevation is about 10 to 20 feet. The escarpment over which one travels is one of the terraces of a previous stand of sea level. This area, as well as the promontory, is lacking in the orange-colored sands of the Citronelle Formation. The sand is fine grained and white or yellow. The absence of lakes is also a conspicuous feature.

The promontory is bordered on the east, then, by Rice Creek Swamp, the origin of which is still being debated. The possibilities include an origin resulting from stream erosion or from marine processes. It has been suggested that the

structure may have been formed by meanders in an old stream (perhaps the ancient Oklawaha), or that it may have resulted from littoral currents. Observation of the presence of Sabal palmetto in the swamp area suggests a relatively alkaline soil, probably because of shell deposits. Several creeks originate on the eastern flank of the Promontory and drain the surface waters into the Rice Creek Swamp drainage system. If one studies the topographic sheet of this area, this drainage pattern appears quite different from that on the western flank. The development of consequent streams on the original slope accounts for the pattern (3).

Once past Rice Creek Swamp, the elevation changes slightly as Palatka Hill or Palatka Island is reached (see Figure 3). It stands at an elevation of about 80 to 100 feet between Rice Creek Swamp and the St. Johns River Valley of today. Beginning with the escarpment, marking the terrace associated with Baywood Promontory, one moves across the remnants of the terraces below that of the Wicomico. The number of terraces crossed is determined by the interpretation one accepts, since interpretations of topographic features continually change as new evidence is found on which to base the changes. The two more recent terraces, the Pamlico and the Silver Bluff, are recognized by most geologists and form a relatively flat plain from Palatka to the coast. A series of ridges and sags mark the landscape; the plowed fields identify the better drained ridges. Between the plowed fields are swampy areas with numerous cypress ponds and drainage ditches. The elevation of this area is generally 10 feet or less. Several places in drainage ditches on the north side of the highway are sources of fossil shells to collect for identification. The drainage in this area is controlled by Haw Creek and the Intracoastal Waterway via a series of drainage ditches and a few small creeks. The area is farmed and produces winter vegetables such as cabbage and potatoes.

At Bunnell (see Figure 4) the elevation rises to about 25 feet, and a series of sand ridges are crossed again between Bunnell and Flagler Beach (see Figure 5). The pines and cabbage palms in company with cypress attest to swampy alkaline soils. Just west of Flagler Beach, outcrops of the Anastasia Formation are in evidence at an old mining pit. The formation is exposed on both sides of the road. These rocks are composed of broken bits and pieces of shells too large to be attributed to wind deposition. The layers slope seaward as will be seen at a later exposure on the waterway. These rocks are the type used to construct the Fort at St. Augustine.

At Flagler Beach, Florida 100 deadends at the shoreline. The beach is steeper than that at Talbot Island and completely different from the shore on the Gulf Coast. The sand contains

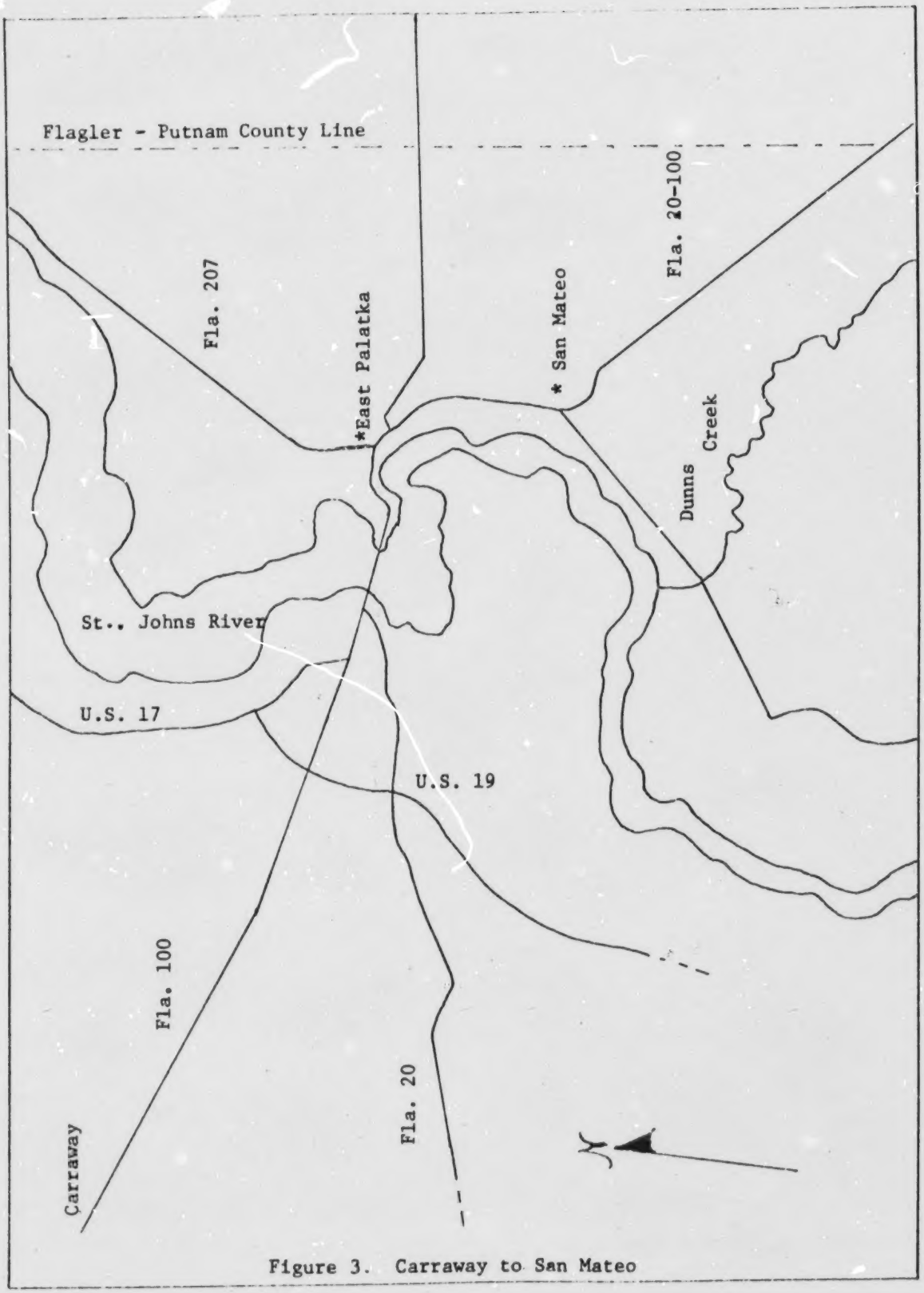


Figure 3. Carraway to San Mateo

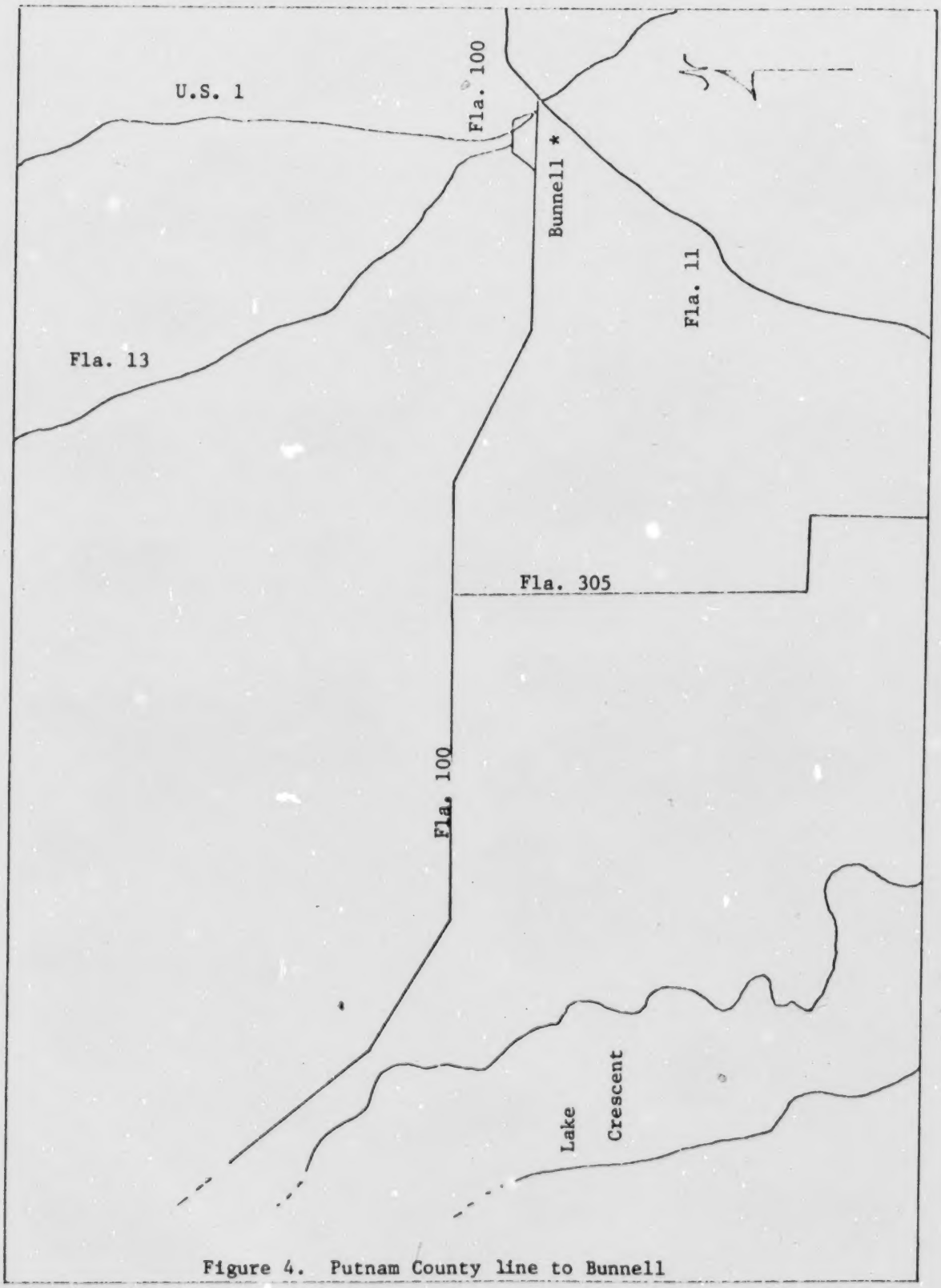


Figure 4. Putnam County line to Bunnell

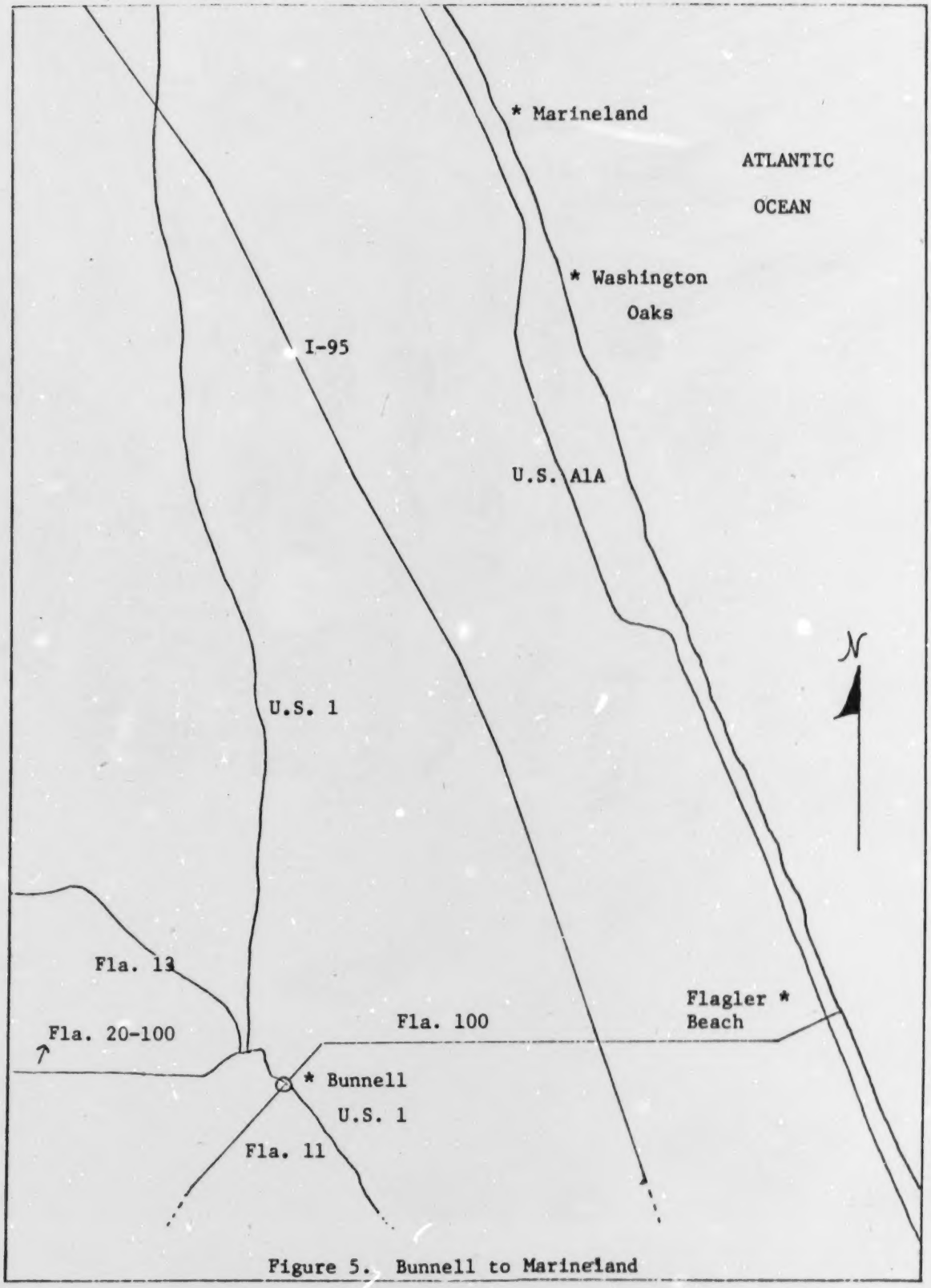


Figure 5. Bunnell to Marineland

more shell material, but the presence of unbroken shells on the beach is lacking. The road, U. S. A1A, follows the beach closely and offers the opportunity to view the characteristic vegetation of a seacoast in this area.

About six and one-half miles north of Flagler Beach a remnant of the old A1A bears left in a crescent-like drive and rejoins A1A about one-half mile to the north. Just off this crescent drive a small dirt road leads to the bank of the Intracoastal Waterway, a distance of perhaps 100 feet. There are additional exposures of the Anastasia Formation (Plate 7). The dip of these rocks is quite evident as one observes them across the Intracoastal Waterway. They are present along the east bank as well and offer examples of solution features and joints (Plate 8).

PLATE 7

"Anastasia" exposed along Intracoastal Waterway

Just north of this exposure is Washington Oaks State Park with an entrance to the beach off A1A. The Anastasia Formation is again exposed and produced a type of beach not characteristic of "Florida beaches" (Plate 9). The rocks stretch south toward Flagler and north toward Matanzas Inlet where they are exposed again on the south shore. The rocks illustrate the effects of the water as pothole-like openings occur, and small tidal pools are evident everywhere.

PLATE 8

Weathered exposure of "Anastasia"

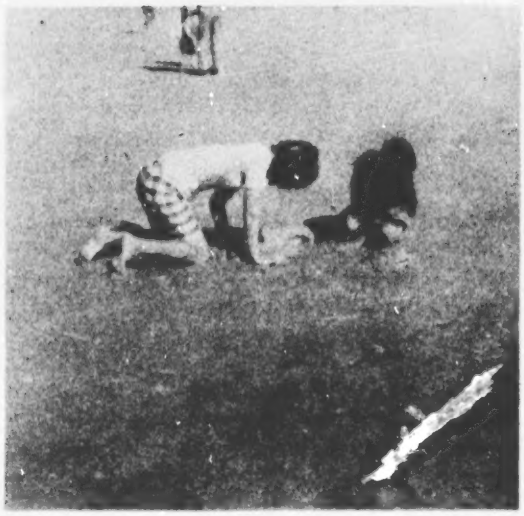
PLATE 9

"Anastasia" exposed on beach

North of this area is Marineland, lying just south of the Matanzas Inlet. This inlet separates Anastasia Island, a barrier island, from the land to the south. The spit of land to the north of the inlet is receiving sediments while the area to the south of the inlet is being starved and eroded. This is similar to the situation at the north end of Little Talbot Island. The north end of the island is being eroded and accretion is occurring at the south end. The current moving through Matanzas Inlet, for example, jets the sand out to sea rather than allowing it to continue its southerly drift along the coast. The dunes and sand deposits on the southern end of Anastasia Island are tremendous. This area can be investigated on the basis of shoreline features for the east coast, and convenient stopping places for buses or cars are available.

Crescent Beach (see Plate 10), a few miles to the north, is reached by paralleling the beach dune ridge on A1A (see Figure 6). Man has occupied this first high dune ridge, and beach cottages line the ridge along the shore. At Crescent Beach, Florida 206 bears left over the Intracoastal Waterway and carries one back up and over the terraces to San Mateo Island and Palatka Hill. The area is again one in which a series of ridges and sags occur with rather poor drainage.

PLATE 10



East coast beach

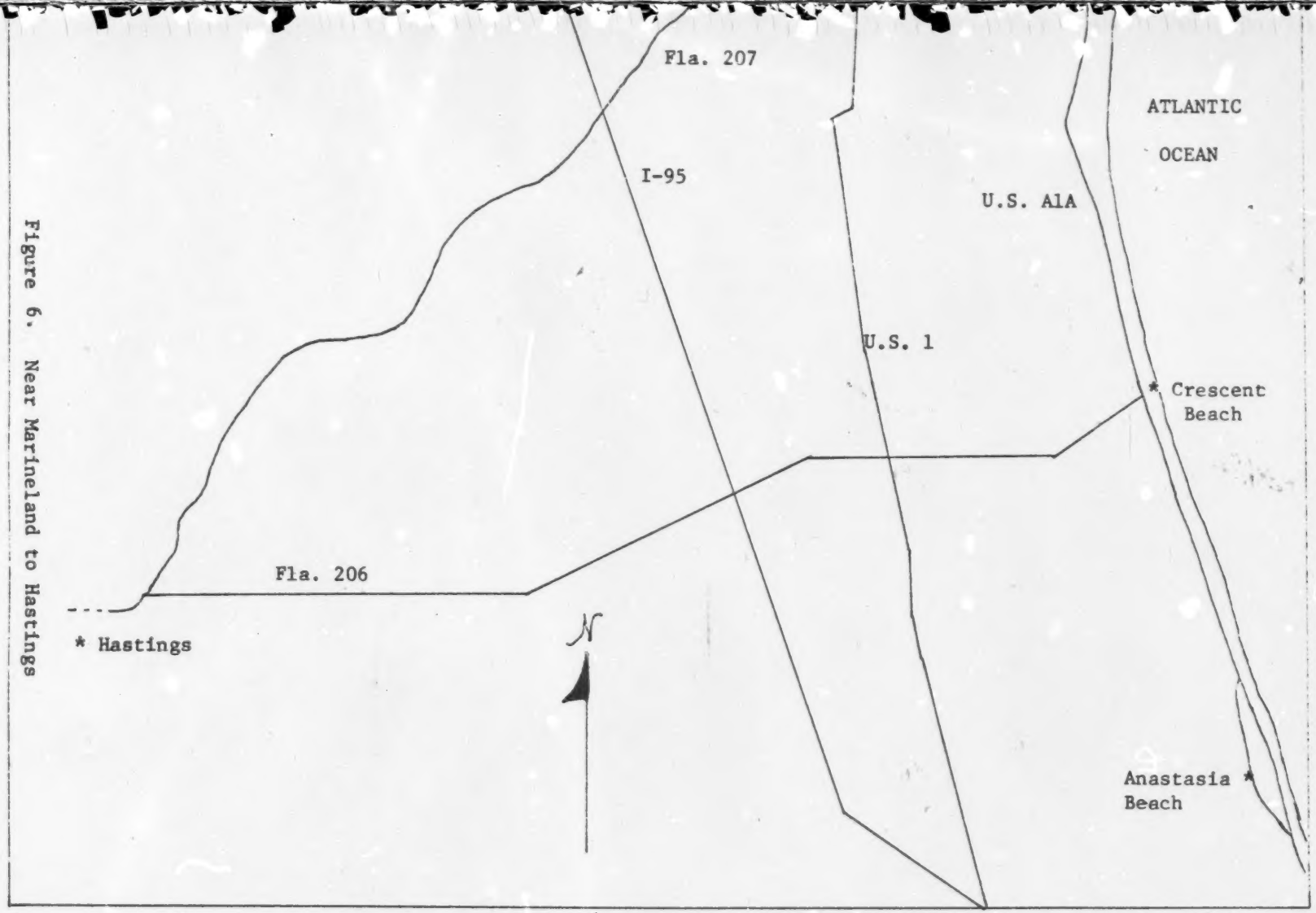


Figure 6. Near Marineland to Hastings

Drainage which does occur parallels the ridges forming swampy areas in the sags. The drainage from these areas is down into the subsurface sediments. This section of Florida is noted for its winter vegetable production because of the still plentiful supply of water. In recent years, however, wells have gone dry and salt water intrusion has occurred in some, while some new wells have yielded nothing except brackish water.

At East Palatka the route rejoins U. S. 17 and Florida 20 and goes through Palatka until Florida 20 turns west toward Gainesville (see Figure 7). A few miles west of Palatka the route drops to an elevation of 10 feet as it crosses Rice Creek Swamp. The route connects with Florida 315 at Interlachen and continues west to Gainesville.

From Interlachen to Gainesville the route is the same as that used in the beginning. The entire route covers about 180 miles and utilizes the entire day. The number of stops made and the time allotted for each one must be decided by the teacher after he considers his objectives and the kind of class with which he is working.

Foci of the Study

Since the area described in this guide covers so many varied environments, several foci are suggested. The teacher who chooses to use the study should select or develop the focus suitable for his own needs. The area around Interlachen may be studied on the basis of the mineral resources. A visit may be planned which includes the Edgar Kaolin Mine, for example. The sands making up the ridge (Grandin-Interlachen ridge) may be the focus for a short visit to the field with examination of the sands being continued in the laboratory. The peat deposits at Florahome may be investigated. This is not suggested as a study to include a visit to the bog itself. The owners of the operation do not encourage students to move out into this area because of their legal responsibility for the safety of the students; however, students may collect samples of the peat and examine it back in the laboratory. The peat from the north shore of Little Talbot Island, for example, may be compared to the peat at this site. If this peat were formed in an old lagoonal area, there should be some similarities between the two samples.

Since the botany and geology of the area are so closely related, these relationships may be used as foci for the study. The presence of the various kinds of vegetation may be associated with general soil conditions present. Students may collect samples of the soils for analysis and to determine moisture content. The level of the surface water may

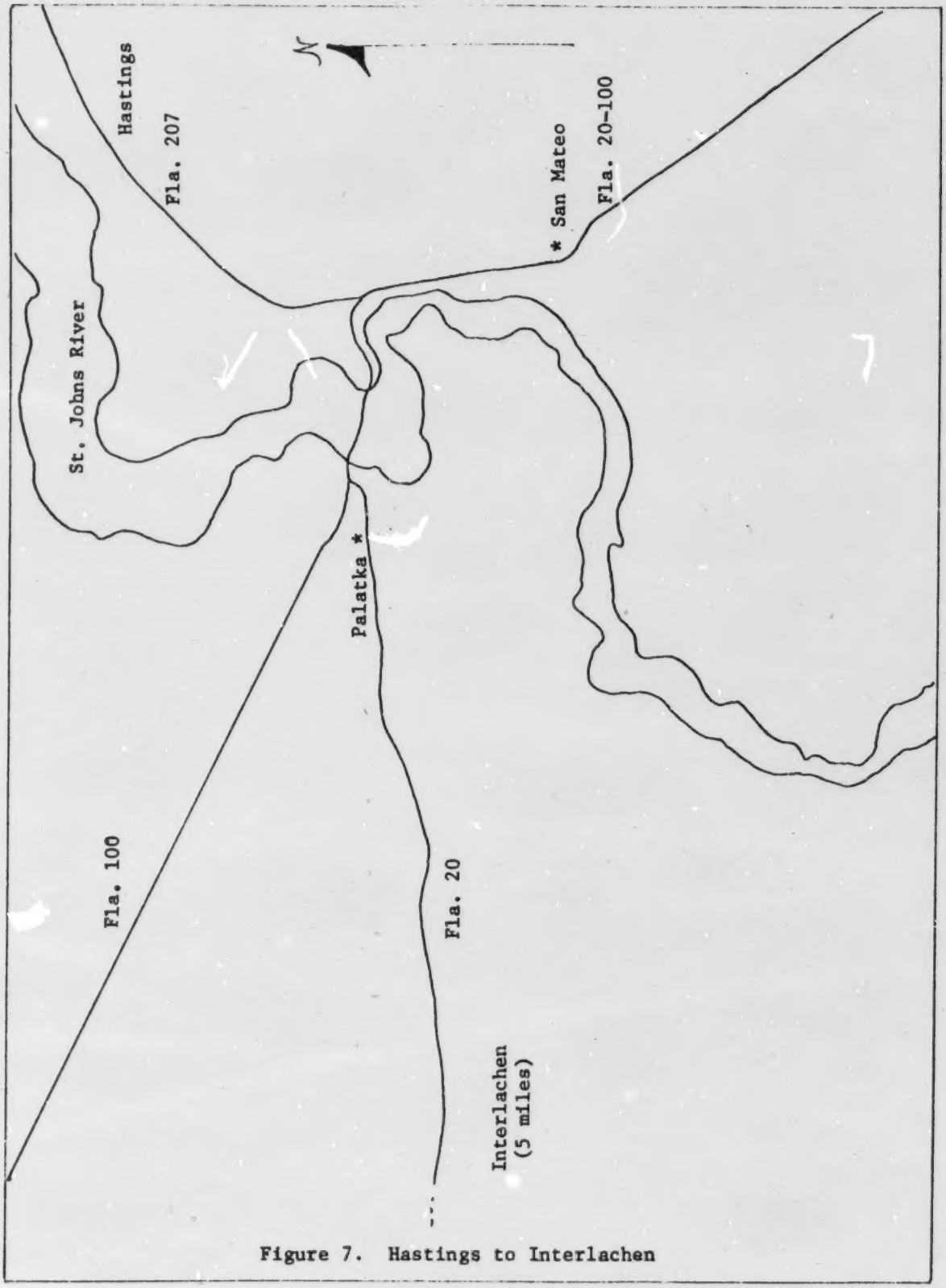


Figure 7. Hastings to Interlachen

be determined in places. A few experiences in this area of study can provide opportunities for students to learn to interpret the geology of an area from the vegetation covering the area.

If coastal features are selected as a focus, a nonstop trip over the route to the beach may be made. The beach from Flagler Beach to Crescent Beach or St. Augustine Beach offers many opportunities to study the shoreline features of a high-energy coast.

Utilization of topographic maps may be emphasized by a running discussion each time the field trip passes from quadrangle to quadrangle. This requires a minimum of one map for each two students in order that students may follow the route on their series of maps.

These suggestions represent only a few of the possibilities for in-depth study of this area. The emphasis must be determined by the teacher as he considers his own background, the capabilities and interests of his students, and the objectives of the field work he is intending to accomplish.

Grade Level to Which Such a Field Trip Is Best Adapted

Because of its length, this trip should be limited to ninth grade or older students. Further, to profit from the trip, students need more background than most younger students possess. However, short portions could be adapted for sixth, seventh, and eighth graders.

Safety Factors, Hazards, or Special Conditions to Consider

The primary safety factors on this trip involve the loading and unloading of the bus or cars along the highway and the nearness to the Intracoastal Waterway. With enough adults and reminders of the dangers as they are encountered these "hazards" are minimized.

Teaching Units to Which the Trip Is Best Adapted

This type of field trip is adaptable to almost any aspect of the school curriculum. The cultural, social, geographical, and historical aspects of the area may be studied. A social studies class making this trip can view areas in light of man's economic utilization. A biology class could study the countryside in light of aspects of botany or

plant succession. A history class could study the rise and decline of the towns along the route and the reasons for this fluctuation. The versatility of such an area is limited only by the imagination and the background of the teacher involved. A fruitful, innovative possibility exists for a series of cooperative, interdisciplinary field trips involving both science and social studies teachers at the same time.

Days and Hours Available for the Trip

Since the distance involved is about 180 miles, the teacher should run through the field trip prior to involving students. The stops should be chosen carefully on the basis of the objectives and a time schedule established to be maintained. To proceed over the entire route requires a full day. The trip may be made on any school day or on a weekend. Since much stopping and starting occurs along the way, a weekday is suggested because of traffic.

Number of Restrictions

The ideal group for any field trip is the small group (approximately 20). The size of the group determines the planning necessary for food and rest stops as well as the number of adults needed to assist. The number of adults who must function in the same capacity as the teacher is also determined by the age of the students. A large group (approximately 60) may be handled successfully if transportation employs a bus, and some means for talking to the students on the bus is available. A large group may be broken into several small groups for the actual field work and maintained in a large group for discussion.

Accommodations

There is no need for accommodations other than sites for rest stops. The number of service stations and restaurants along the way are innumerable and available. The writer suggests that these stops be planned ahead by the teacher also, and the permission of the restaurant owner or the service station manager be obtained.

Fees

No fees are required except monies necessary for students to use for snacks, assuming that the cost of transportation is paid by the school system.

Educational Purposes Possible of Achievement

The purposes and objectives of any field study must be determined by the teacher and the students. The study may aim at developing skills in the students which may be categorized under either cognitive, affective, or psychomotor domains. The student may be involved in both quantitative and empirical observations of the area under study. His participation in a bus trip and as part of the large group and of the smaller groups will lead to changes in the affective area. The teacher must plan these purposes and objectives carefully with the students if such a trip is to be rewarding educationally.

A detailed description of the process for developing behavioral objectives and a model student field-study guide are contained in A Case Study of Hogtown Creek: A Justification for Field Observations, The Devil's Millhopper: A Resource Guide for Field Study, and Little Talbot Island: A Resource Guide for Field Study. These publications are available from the P. K. Yonge Laboratory School on request.

Activities

The activities on any such study fall into three categories: (1) pre-trip planning activities, (2) field-trip activities, and (3) follow-up activities.

Pre-trip activities might include text studies related to the purposes, objectives, and/or guidelines specified for the trip. Resource personnel (botanists, geologists, naturalists, etc.) may help prepare students for the kinds of observations being considered. A study of topographic maps of the entire area is necessary. The absence of streams and the presence of lakes or sinks, for example, will be noted by some of the more perceptive students. The object of pre-trip activities is to raise and state the questions which will serve as guidelines for gathering information and finding answers during the trip.

Field activities are conducted in two phases: (1) viewing from the bus or stopping to examine certain features more closely and (2) stopping at the end of each section of the field trip for a discussion of the area over which the route has carried the class. A large bulletin board on which the topographic maps can be mounted for large-group viewing and discussion of the area should be carried.

Within these two phases students and teachers should record their observations and comments by using a pencil or a camera. An outcome of recordings should be an annotated

road log or journal and a set of photographs or slides of the area visited. Stops for photographs of features characteristic of the area should be made. Stops need not require loading and unloading of the bus unless close examination of a feature is desired.

The purchase of inexpensive cameras (Instamatics and/or Swingers) by the Science Department or the Audiovisual Department is strongly recommended. Many students have cameras; many students, however, have never held a camera in their hands. The opportunity to use a camera may be reason enough for a student to pay close attention to the area over which he is traveling. Becoming adept at using such a camera may have far-reaching effects in the cognitive, psychomotor, and affective areas of learning.

Follow-up activities should capitalize on the work of the students. A display, made by students, using sheets of white cardboard attached to a wall in the classroom, serves to map the route of the field trip. Various features along the route are recorded by the addition of pictures taken by the students, their comments, and by symbols they construct from colored paper or with colored pencils.

The topographic maps should be restudied and the students' observations in picture or note form correlated to the structures indicated on the maps. The pictures and notes may profitably be compared to those recorded on a trip to the Cedar Keys area on the west coast. Maps of both coastlines may be compared and their similarities and differences discussed. Now is the time and place for proposing answers to old questions and formulating new ones.

Resource people may be recalled to the class for further discussion if student interest has been maintained. If follow-up activities are extended over too long a period of time, student interest begins to deteriorate. The individual teacher is the only judge of the appropriate length of time to be devoted to these activities.

Teaching Aids and Printed Materials Available

Topographic maps of the area are available from the Map Information Office of the U. S. Geological Survey in Washington, D. C. County road maps are available from the Office of the State Road Department, Tallahassee, Florida. Other maps such as Vegetation and Soils Maps may be obtained from the nearest U. S. Department of Agriculture office.

Slides were produced for use in the classroom after the field trip. The slides illustrate some of the features to be observed along the route chosen for this field study and are represented by Plates 1-10 of this monograph.

ROAD LOG

Miles

0 Waldo Road and University Avenue. Elevation 175 feet a.s.l.

3.9 Newnan's Lake. Sixty-eight feet a.s.l. Pine flatwoods with understory of saw palmettos and small trees. Isolated hardwood areas.

Prairie Creek Dam—controls the level of Newnan's Lake. Flows into Orange Lake and finally into the Atlantic.

8.3 Junction Florida 325 to Cross Creek. Cypress ponds, cabbage palms, pine flatwoods. Undulating terrain with swampy areas on both sides of the road.

10.1 Grove Park. Sits on a hammock about 100 a.s.l.

10.9 Lochloosa Creek. Drains area east of Newnan's Lake from the 100-foot contour to northwest of Hawthorne. Pine flatwoods area.

14.4 Hawthorne. Higher hammock. About 150 feet a.s.l. Evidence of karst topography begins to appear. Longleaf pine.

16.4 Putnam County Line. Fowler's Swamp, an area where peat is filling the basin. Bordered on east by the orange sands of "citronelle." Between here and Interlachen numerous lakes appear. Generally believed to be solution lakes formed by solution in limestones buried beneath Miocene sands and gravels of the Citronelle Formation.

22.8 Devil's Sink on the left and Lady Slipper Lake on the right. A path leads up over the bank on the left side of the road. This sink has penetrated the Hawthorne materials and connected with the Eocene limestones.

24.8 Rosemary—a shrub associated with dry sand hills. This shrub is found growing on similar dune areas between Gainesville and the Gulf Coast.

26.9 Lake Chipco on left in town of Interlachen. This is a solution feature. The lake has steep sides of a collapse sink and connects with the Eocene limestones.

27.2 Junction 315. Florida 315 follows the Grandin-Interlachen Ridge north to the town of Grandin. The area is relatively well-drained with longleaf pines and oak. Sand pits on both sides of the road. Sand pit on the left is a good place to stop and point out the cross-bedding that it present in these hills.

31.5 Rolling terrain; sinks on both sides of the road. Between here and Grandin there is a low swampy area on the right (Florahome Valley).

34.3 Junction Florida 100. Turn east toward Palatka. Swampy area on right. Tall cabbage palms in view on right.

36.2 Florahome. Sits on an "island" at about 122 feet a.s.l. Phillips 66 station on right can be used as rest stop.

37.9 Peat deposits. The area just south of Florida 100 is underlain by deposits of peat that are being mined commercially. Samples may be examined at the offices of these mines. Immediately past these deposits the elevation changes, the terrain changes. The sand hills are occupied by oaks and pines. Note absence of orange sands of the "citronelle." Sands are white or yellowish.

40.5 Elevation continues to increase until the Baywood Tower is reached. The elevation here is about 167 feet a.s.l.

45.6 Small creek is crossed. Area is now pine flatwoods with rather poor drainage. This general area is known as Rice Creek Swamp with an elevation ranging from 10 to 20 feet a.s.l. Cypress trees, drainage ditches and a few farmlands suggest differences in soil and water conditions.

51.3 Junction U. S. 17. Turn south. Bank of the old Pamlico shoreline on right just before intersection. Proceed south across the St. Johns River to intersection with Florida 20 and 100.

57.6 San Mateo Island. Approximately 80 feet a.s.l.

58.0 Junction Florida 20 and 100. From here eastward the topography changes. The vegetation is again pine flatwoods associated with poorly drained areas. The drained areas are farmed.

64.0 Flagler County Line. Approximate location of the Pamlico terrace. Pine and palmetto area. Drainage ditches and standing water in evidence. An area of ridges and the water draining into the slight sags.

71.5 Drainage ditch paralleling the highway provides a good site for collection of fossil shells. Cabbage and potato fields on both sides of the road.

80.8 Bunnell City limits. Junction with U. S. 1 south. Turn left on Florida 100 and proceed eastward. The area is still poorly drained flatwoods with cabbage palms.

86.5 Intersection with I-95. Approximately one-half mile beyond this intersection, the Anastasia Formation is exposed on both sides of the highway. Wayside park on right is convenient for lunch stop and for investigation of the Anastasia Formation.

88.6 Flagler Beach City limits. Rise in elevation to a ridge about 25 to 30 feel a.s.1.

89.4 Intracoastal Waterway. Salt marshes present on both sides.

89.9 Intersection U. S. AlA and Atlantic Ocean. Several stations available for rest stops. Lunch on beach if desired.

91.1 Looking west note abandoned Lehigh cement plant visible through tree line.

96.5 Bear left on remnants of old U. S. AlA to the Intracoastal Waterway. The Anastasia Formation is exposed on both sides of the channel. The dip of the formation toward the old coastline can be noted by looking at beds across the channel.

101.8 Washington Oaks Park. Turn right at park entrance toward the beach. Tables are available for lunch if desired. Extensive beach area covered with exposures of the Anastasia Formation. Solution effects of water can be seen in rocks. Typical near beach vegetation obvious.

104.1 Marineland.

106.9 Matanzas Inlet. Excellent stopping place. Erosional and depositional features associated with inlets visible here. Rocks exposed on south side of inlet. Sand spit developing on north side of inlet.

111.6 Junction Florida 206. Crescent Beach. American Oil Station on left for rest stop. Turn left toward Hastings. Depending on kind of transportation used, an alternate route to Hastings may be necessary. Bridge over the Waterway has weight limitations and may need to be bypassed by proceeding to St. Augustine and then to Hastings via Florida 207.

115.3 Intersection Route U. S. 1.

117.5 Intersection with I-95.

125.7 Junction Florida 207.

134.2 East Palatka.

135.2 Junction U. S. 17 and Florida 20 and 100. Turn northward and proceed through Palatka until Florida 20 turns west to Gainesville.

137.8 Junction Florida 20. Turn left and proceed westward toward Gainesville.

140.4 Junction U. S. 19.

144.4 Rice Creek Swamp. Elevation has dropped again to the 10 to 20 foot a.s.l. Same topographic features seen earlier in the day farther north.

153.1 Junction with Florida 315. Return to Gainesville by Florida 20, the same route used earlier in the day.

180.0 Intersection of Waldo Road and University Avenue.

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